MODULAR PAINT OVEN

RELATED APPLICATIONS

[00001] This application claims priority to United States Provisional Patent Application No. 60/453,560 filed March 11, 2003.

BACKGROUND OF THE INVENTION

[00002] Automotive and industrial paint are typically baked at temperatures between 200 and 400° F in ovens positioned at the end of paint application booths in production painting facilities. These ovens typically include an oven housing that encloses heating apparatus for applying either radiant or convection heating as is known to those of skill in the art.

[00003] Preferably, these ovens are constructed from modules that are manufactured at a fabricating facility and transferred to the production paint facility. The modules are then affixed together to form the oven housing through which a conveyor transfers the products that have been painted. A typical module includes side walls, a roof and a floor, and has a length of between about 20 and 40 feet. Thermal insulation is sandwiched between inner and outer panels to prevent heat from escaping from the housing while in operation. Present designs include significant structural components that have proven to unnecessarily add cost to the construction of the oven. Structural members are welded to wall panels in both vertical and horizontal directions prior to applying the outer panels. These structural members, which are fashioned from heavy gauge steel, add a significant amount of material costs to the oven, which has proven unnecessary, particularly in light of increasing steel costs.

[00004] A typical automotive paint oven is known to be up to several hundred feet long. Thus, unnecessary structural components included in each module

will add cost to the oven several times over. Therefore, a simple construction that reduces unnecessary structural components would be desirable to reduce the overall material usage and cost of the oven.

SUMMARY OF THE INVENTION

[00005] The present invention relates to an oven assembly for drying paint on a product transported by a conveyor. A plurality of modules are positioned in a generally abutting relationship, each having a roof, side walls, and a floor defining a length and a width. The floor is formed from abutting floor panels reinforced by a plurality of support members spaced along the length of the floor. The support members have a length greater than the width of the floor. The side walls include an inner side wall panel disposed in an overlapping relationship with the floor and a side wall cladding panel supported by the support members along the width of the floor concealing thermal insulating material disposed between the inner side wall panel and the side wall cladding panel.

[00006] It has been determined that the heavy structural members associated with prior art ovens are not necessary, primarily because the oven does not provide structural support but merely retains heat to cure the coating applied to the product. Therefore, the present invention provides a light weight alternative that is easily manufactured at a remote location and transferred to the location intended for use.

BRIEF DESCRIPTION OF THE DRAWINGS

[00007] Figure 1 shows a perspective view of the inventive oven module;

[00008] Figure 2A shows a partial perspective view showing the intersection of the walls, floor, and roof of the inventive oven module;

[00009] Figure 2B shows a perspective view of a floor panel;

[00010] Figure 3 top sectional view of inner wall and the outer wall cladding;

[00011] Figure 4 shows a partial top view of a preferred layout roof panels and explosion panels;

[00012] Figure 5 shows a side, longitudinal, sectional view of intersection between the roof panel and the explosion panel;

[00013] Figure 6 shows a perspective view of adjacent oven modules; and

[00014] Figure 7 shows a front view of the oven having a floor radiant heat assembly in place.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[00015] An oven module of the present invention is generally shown at 10 in Figure 1. The module 10 includes side walls 12, a roof 14, and a floor 16.

[00016] As best shown in Figures 2A and 2B, the floor is fabricated from a plurality of floor modules 18. The floor modules 18 are generally rectangular in shape and preferably are arranged longitudinally with respect to the length of the oven module 10. Preferably, three rows of floor modules 18 are positioned in an abutting relationship to form the entirety floor 16 (see also Figure 1). The floor modules 18 are supported by support member 20 that extend across the width of the oven module 10 preferably positioned beneath the seam 22 formed between abutting floor modules 18. A hot air inlet 19 is disposed in the floor 16, the purpose of which will be explained further below.

[00017] Each floor module 18 is formed from two floor panels 24, one of which is best represented in Figure 2B. Each floor panel 24 includes a panel base 26 having an upward extending panel flange 28 that is generally perpendicular to the panel base 26. Each panel flange 28 terminates in a terminal flange 30 that is generally

perpendicular to the panel flange 28 so that the floor panel 24 defines a box-like structure. Each floor panel 24 is filled with thermal insulating material (not shown) and mated to a second floor panel 24 so that the terminal flanges 30 of the two panels 24 abut enclosing the box-like sections and sealing the thermal insulating material inside. The two floor panels 24 are either spat or stitch welded 25 together at the seam defined by the abutting terminal flanges 30 to form the floor module 18. The combination of the box like structures 24 and the support members 20 provide ample structural support to the assembly 10.

[00018] The support member 20 has a length that exceeds the width of the three abutting floor panels 24 as best shown in Figures 1 and 2A. A generally U-shaped channel 32 is secured to opposing ends of the support member 20 that extend beyond the width of the floor 16. The U-shaped channel 32 includes an upper, horizontal lip 33 that partially encloses the U-shaped channel 32. The U-shaped channel 32 extends along the length of the oven module 10, the purpose of which will be explained further below. The interaction between the floor panels 24, the support member 20, and the U-shaped channel 32 is shown best in Figure 3A. Preferably, the U-shaped channel 32 is bolted or similarly fastened to each of, or some of, the support members 20 with fastener 35.

[00019] Referring again to Figure 2A, the side wall 12 is formed from a plurality of side wall panels 34 each having a panel base 37 with a flange 36 extending outwardly from the panel 34 at a generally 90 degree angle defining the perimeter of the panel 34. The flange 36 defines a box-like enclosure with the panel base 35 to receive thermal insulating material 38. The insulating material is fastened to the side wall panels 34 with a welded pin (not shown) having a washer disposed upon a distal end.

[00020] The side wall panels 34 define the interior surface of the side wall 12 of the oven module housing 10. The side wall panels 34 are positioned inboard of the

generally U-shaped channel 32 in an overlapping relationship with a side edge of the floor modules 18 defining the longitudinal sides of the floor 16 as best shown in Figure 2A. The side wall panels 34 are welded or otherwise secured to the floor 16 as will be described further below. It should be understand that adjacent wall panels 34 are also welded together at the seam 39 (Figure 1) defined by abutting wall panels 34 so that an airtight side wall 12 is formed.

[00021] Cladding panels 40 shown are received by the generally U-shaped channel 32 to cover the thermal insulating material 38 retained by the side wall panels 34. The horizontal lip 33 pinches the cladding panels 40 to the U-shaped channel 32 to secure the cladding 40 to the module 10. The side wall cladding panels 40 are positioned in an abutting relationship to fully conceal the thermal insulating material 38, but are not otherwise adjoined by welding or fastening. However, metal screws (not shown) may be used to provide additional retention to the wall panels 34. As best shown in Figure 3, a side flange 42 extends along vertical edges of each cladding panel 40 in a generally perpendicular relationship to a cladding panel base 40 in a direction facing the inner side wall panels 34. A first terminal flange 44 extends in an inboard direction from one of the side flanges 42 at generally perpendicular relationship and a second terminal flange 46 extends in an outboard direction from of the other side flange 42, also in a generally perpendicular relationship to the side flange. The first terminal flange 44 and the second terminal flange 46 of adjacent cladding panels 44 overlap enclosing the seam formed by the abutting cladding panels 40 to prevent the thermal insulating material 38 from becoming exposed during the varying thermal expansion and contraction of the adjacent cladding panels 40, which could result in a gap between the adjacent cladding panels 40.

[00022] Referring now to Figures 2A and 4, the roof 14 of the oven module 10 is formed from roof panels 64, and explosion panels 48 that are generally

rectangular, the length of which is oriented to extend between each of the side walls 12. A roof flange 50 extends upwardly from a roof panel base 51 along the perimeter of each of the roof panels 48. A support member 52 extends along the entire length of the oven module 10 along the intersection between each side wall 12 and the roof 14. The support member 52 includes an inner vertical support wall 54, a first horizontal wall 56 and a second horizontal wall 58, each of which are generally perpendicular to the inner vertical support wall 54. The second horizontal wall 58 is positioned outboard of the first horizontal wall 56, the purpose of which will be explained further below. An outer vertical support wall 55 joins the two horizontal walls 56, 58. The inner vertical support wall is affixed to the roof flange 50 of the roof panels 64 by connecting panel 60 and rivets, welds or equivalent fasteners 62 fixedly attaching the connecting panels 60 with the first horizontal wall 56 and a roof flange 50. The connecting panels 60 are spaced as necessary along the length of the oven module 10, but not necessarily to each of the roof panels 48, and preferably not to any of the explosion panels 48.

[00023] As shown in Figure 4, the explosion panels 48 are spaced lengthwise of the oven module 10 intermittently between roof panels 64. Figure 4 shows these explosion panels 48 positioned between every roof panel 64. However, the explosion panels 48 may be positioned between every other roof panel 64, every second roof panel 64, or even every fourth roof panel 64 as necessary.

[00024] Figure 5 shows a functional interface between the roof panel 64 and the explosion panel 48. A first member 66 has an upwardly extending wall 68 is affixed to the roof panel 64. A second member 70 has a second upwardly extending wall 72 abutting the first upwardly extending wall 68 and is affixed to the explosion panel 48. The members 66, 68 are also preferably positioned between each explosion panel 48. The second upwardly extending wall 72 has a reverse bend 74 that overlaps the first

upwardly extending wall 68 of the adjacent first member 66 thereby adjoining the first member 66 to the second member 70. For retention, a button punch (not shown) squeezes the reverse bend 74 to pinch the first upwardly extending wall 68. In the event of an explosion, the button punch releases and the explosion panel 48 lifts upwardly to provide a pressure release from the explosion thereby preventing structural damage to the oven module 10. Therefore, the seam formed between the explosion panels 48 and the wall panels 34 is preferably not welded to allow the explosion panels 48 to lift upwardly.

[00025] Referring again to Figure 2A, each wall cladding panel 40 engages the second horizontal wall 58 and the outer vertical support wall 55 of the support member 52 and is retained as previously stated by the generally U-shaped channel 32 at the bottom. A roof cladding panel 76 rests upon the first horizontal wall 56 of the support member 52 so that all of the thermal insulating material 38 is now covered. A molding 78 (Figure 1) conceals the seams formed between the support member 52, the wall cladding 40, and the roof cladding 76 and assists retaining the wall cladding panels 40 to the module 10.

[00026] As best shown in Figure 6, expansion joints 80 are positioned between adjacent modules 10 as needed. Expansion joints may be positioned between every other module 10, every other second module 10, or every other third module 10 depending on the thermal expansion properties expected of the final oven design. The expansion joints 80 reduce the structural stress associated with the thermal expansion of the materials. Preferably, the expansion joint 80 is formed from a heat resistant fabric, however, other resilient materials may also be used.

[00027] The preferred oven 10 substrate material is aluminized steel. Aluminized steel is known to those of skill in the art to provide a more durable substrate than does galvanized steel and is less expensive than stainless steel.

[00028] During the assembly process, the floor 16 is first assembled using the components set forth above. Upon welding the seams between each of the floor panels 24, the floor 16 becomes airtight. After the floor 16 is assembled, conveyor supports 82 are affixed to the upper surface as needed as best seen in Figure 7. Additional ribbing (not shown) may also be welded to the underside of the panels 24 below the conveyor supports 82. Each of the side walls 12 are also manufactured separately using the components set forth above. Temporary braces (not shown) secure the walls 12 in an upright position at appropriate spaced distances when the walls 12 are set upon the floor 16 in the overlapping relationship described above so that the walls 12 can be welded in place to provide an airtight seam. Once the walls 12 are place, the roof panels 48 are welded in place and the support members 52 are affixed to the roof panels 48.

[00029] Once all the panels 24, 34, and 48 are in place, the thermal insulating material 38 is positioned on the exterior surfaces of the side wall panels 34 and the roof panels 48. After the insulating material 38 is in place, the wall cladding panels 40 are secured in the generally U-shaped channel 32 and upon the second horizontal wall 58 of the support member 52. Once the wall cladding panels 40 are in place, the roof cladding panels 76 are placed upon the roof panels 48 and the molding 78 is positioned to cover the seam between the wall cladding panels 40 and the roof cladding panels 76.

[00030] Each module is completed in a similar fashion and transported to the production painting facility where several modules are affixed together to form the entirety of the oven assembly. Depending upon the heating zone, the radiant heat ducts or convection heat ducts are put in place to either provide radiant or convection heat as desired.

[00031] As disclosed in United States Patent No. 5,568,692, one preferred

method of heating the oven through convection heat is from the floor 12. As shown in Figure 7, a radiant wall 83 overlays the floor 12 and is supported by spacers 84 positioned between the radiant wall 83 and the floor 12. Heated air is pumped through a space 85 defined by the radiant wall 82 and the floor 12 via heated air inlet 19. The heated air transmits heat through the radiant wall 83 to heat the oven assembly 10. Optionally, air supply ducts 86 are included to provide fresh air and remove solvent laden air from the oven.

[00032] The invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

[00033] Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, wherein reference numerals are merely for convenience and are not to be in any way limiting, the invention may be practiced otherwise than as specifically described.